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Composition induced structural evaluation in BO3-3, PO4-3 and SO4-2 substituted CaMoO4:Dy3+ phosphors for application in White-Light LEDs

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A series of novel white light emitting CaMoO4:Dy3+ (1.0 mol %) phosphors substituted with different anionic groups (BO3-3, PO4-3 and SO4-2) were prepared using a high temperature solid state reaction method. The effects of anionic substitution on the crystalline structure and photoluminescence (PL) properties of the CaMoO4:Dy3+, CaMoO4-BO3:Dy3+, CaMoO4-PO4:Dy3+and CaMoO4-SO4:Dy3+ phosphors were investigated. The X-ray diffraction (XRD) patterns confirmed that the phosphors to be crystallized in a pure scheelite-type tetragonal structure. The field emission scanning electron microscopy (FE-SEM) images showed that the particles were agglomerated together and they had no definite size. The chemical composition analyses and the electronic states were analyzed using the energy-dispersive X-ray spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS) respectively. The Fourier transform infrared spectroscopy (FTIR) data supplemented both the XRD and EDS data by confirming that the stretching mode frequencies were all related to BO3-3, PO4-3 and SO4-2 except a few absorption peaks ascribed to atmospheric moisture and hydrocarbons. The band gaps measured from the ultraviolet visible spectroscopy (UV-Vis) data were shown to vary for the different anionic group systems. The excitation spectra of the phosphors were characterized by broadband extending from 250 to 500 nm. Upon near-UV excitation, the phosphor emits intense blue and yellow light with a weak red bands, which originated from 4F9/2⟶6H15/2, 6H13/2, 6H11/2 transitions of Dy3+ ion respectively. Furthermore, high intensity white light color emission was achieved by substitution of different anionic groups (BO3-3, PO4-3 and SO4-2) into the CaMoO4:Dy3+ phosphors. Among all the studied phosphors, the CaMoO4-SO4:Dy3+ phosphor showed the strongest PL emission compared to all other phosphors suggesting that it is a promising potential candidate for red emission in the near UV excited white LED applications.

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N/A

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